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Part IV

Department of Energy

Office of Conservation and Solar Energy

Energy Conservation Program for Consumer Products; Test Procedures for Furnaces and Public Hearings

DEPARTMENT OF ENERGY

Office of Conservation and Solar Energy

10 CFR Part 430

Energy Conservation Program for Consumer Products; Proposed Rulemaking and Public Hearing Regarding Amendments to Test Procedures for Furnaces

AGENCY: Department of Energy.

ACTION: Proposed rule.

SUMMARY: The Department of Energy hereby proposes to amend its test procedures for furnaces to include test procedures for pulse combustion and condensing furnaces and to include certain technical revisions. These test procedures are part of the energy conservation program for consumer products established pursuant to the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act. Among other program elements, the legislation requires that standard methods of testing be prescribed for covered products.

DATES: Written comments in response to this notice by March 4, 1980; requests to speak at the public hearing by February 13, 1980; speakers to be notified by February 18, 1980; statements by 4:30 p.m., Febraury 22, 1980; hearing to be held on February 27, 1980, 9:30 a.m.

ADDRESSES: Written comments, requests to speak at the public hearing, and statements to: Department of Energy, Office of Conservation and Solar Applications, Docket #CAS–RM–79–104, Mail Stop 2221C, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585.

Public hearing to be held at: Department of Energy, Room 3000A, Federal Building, 12th Street and Pennsylvania Avenue, N.W., Washington, D.C. 20585.

FOR FURTHER INFORMATION CONTACT:

James A. Smith, U.S. Department of Energy, Office of Conservation and Solar Applications, Division of Buildings and Community Systems, Consumer Products Efficiency Branch, Room 2248, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585 (202) 376–4814.

Carol A. Snipes (Hearing Procedures), U.S. Department of Energy, Office of Conservation and Solar Applications, 20 Massachusetts Avenue, N.W., Mail Stop 2221C, Washington, D.C. 20585 (202) 376–1651.

William J. Dennison, U.S. Department of Energy Office of General Counsel, 20 Massachusetts Avenue, N.W., Room 3238, Washington, D.C. 20585, (202) 376–4100.

SUPPLEMENTARY INFORMATION:

A. Background

On May 10, 1978 (43 FR 20147), the Department of Energy (DOE) published in the **Federal Register** final test procedures for furnaces, as part of DOE's energy conservation program for consumer products. This program was established pursuant to Title III, Part B of the Energy Policy and Conservation Act (Act) (Pub. L. 94–163).[1] Section 323 (42 U.S.C. 6293) of the Act requires that standard methods of testing be prescribed for covered products. Test procedures for furnaces and other covered products appear at 10 CFR Part 430, Subpart B.

On May 29, 1979 (44 FR 30978), DOE published an advance notice of proposed rulemaking which invited interested persons to present written data, views and arguments with respect to the need for amending DOE's test procedures for furnaces in order to address any areas which interested persons felt should be expanded or changed, and to include in the test procedures two new furnace designs, pulse combustion furnaces and condensing furnaces.

DOE has learned that some manufacturers, through the experience of testing, have identified areas of concern in the test procedures which they feel should be expanded or changed. A number of such areas of concern have been the subject of applications for exception to DOE's Office of Hearings and Appeals (OHA) and the findings of OHA are available from the Public Docket Room, Room B210, 2000 M St., Washington, D.C. 20461, Monday through Friday, 1:00 P.M. to 5:00 P.M. On the basis of information submitted with applications to OHA, comments submitted in response to the advance notice, and other available information, DOE today is proposing to amend its test procedures for furnaces as discussed below.

B. Discussion

1. Condensing and pulse combustion furnaces

An application for exception from the furnace test procedures (Case Number DEE–2091) was filed with OHA by Hydrotherm, Inc., a manufacturer of furnaces. The application called DOE's attention to two new furnace design features whose energy consumption characteristics were determined by OHA not to be measured accurately by existing furnace test procedures. One feature uses a method of producing heat by a steady sequence of explosions instead of continuous flames used by other furnaces. The steady sequence of explosions is termed "pulse combustion." The other new design feature employs methods of recovering the latent heat of vaporization from the moisture content of the products of combustion, by condensing part of the water generated by burning the hydrogen present in fuels and then draining this condensate. Boilers and other furnaces which recover latent heat are termed "condensing furnaces." In other furnaces this heat is lost. DOE is today proposing test procedures to determine more accurately the energy consuming characteristics of pulse combustion and condensing furnaces. DOE believes that measures of energy consumption determined by the proposed test procedures can be used fairly to compare these two kinds of furnaces with other furnaces.

The proposed test procedures for pulse combustion and condensing furnaces were developed by the National Bureau of Standards (NBS) at the direction of DOE. NBS investigated two alternative procedures. One method, similar to existing DOE test procedures for other furnaces, requires the measurement of heat loss through the flue (flue-loss method) and is the method proposed today. The second method requires the measurement of the heat output of the furnace (input-output method). NBS found experimentally that the annual fuel utilization efficiency of condensing furnaces, as measured by the input-output method, would require measurement of the temperature and moisture content of combustion air and barometric pressure. In addition, in order to obtain repeatable test results by the input-output method these variables should be controlled to standard values. The accurate control of these variables would require an environmental chamber and would thereby substantially increase the burden of testing.

NBS found that flue gas temperatures and flue losses for condensing forced air furnaces are primarily dependent upon return air temperature, and that for condensing boilers these same variables are primarily dependent upon return water temperature. Flue gas temperatures are essentially independent of the temperature and moisture content of combustion air and barometric pressure. Measures of energy consumption for condensing furnaces can be determined from highly repeatable flue temperature

[1] Subsequently, the Act was amended by the National Energy Conservation Policy Act (NECPA) (Pub. L. 95–619). Reference in this notice to "the Act" or to sections of the Act refer to the Energy Policy and Conservation Act as amended by NECPA.

measurements at specified return air/water temperatures and from calculations of flue losses assuming specified characteristics of the combustion air. Because the flue loss method accurately measures energy consuming characteriatics but, unlike the input-output method, does not require the added burden of measurement or control of cumbustion air temperature, moisture content and barometric pressure, the flue loss method is used in the test procedures proposed today.

Test procedures proposed for condensing furnaces include a steady state performance test (section 3.1.3 of Appendix N), a cool-down test (section 3.2.3 and 3.2.4 of Appendix N) and a heat-up test (section 3.3.3 and 3.3.4 of Appendix N). In section 2.5 of Appendix N the proposed test procedures for condensing furnaces differ from the test procedures applicable to other kinds of furnaces in that return air temperatures are limited to within 5°F of laboratory ambient temperatures in the case of force air condensing furnaces, and water temperature rise is required to be between 19.5°F and 20.5°F in the case of condensing boilers. These specifications are necessitated by the fact that the amount of latent heat recovered from the products of combustion in condensing furnaces is dependent upon return air temperature or return water temperature. If the revised laboratory conditions were not specified, the annual fuel utilization efficiency and estimated annual operating cost would be expected to vary significantly from test to test.

In addition, since pulse combustion furnaces allow no air flow during the off-period, and off-cycle losses are small, the proposed test procedures would permit, at manufacturers' option, testing only under steady state conditions as specified in section 3.6 of Appendix N. Use of only steady state test would probably result in a slight decrease in the annual fuel utilization efficiency and a slight increase in the estimated annual operating cost of a pulse combustion furnace, because all such furnaces known to DOE are also condensing furnaces and steady state testing would not give credit for the extra latent heat recovered during the off-period. The optional test procedures would, however, reduce testing burden without any significant loss of accuracy in measures of energy consumption.

A National Bureau of Standards technical background document entitled "Recommended Testing and Calculation Procedures for Estimating the Seasonal Performance of Residential Condensing Furnaces and Boilers" is available for inspection in the DOE Freedom of Information Office, Forrestal Building, Independence Ave., and L'Enfant Plaza, S.W., Washington, D.C. 20585, between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday.

2. Finned tube boilers

Application for exception filed with OHA by Raypak, Inc. (case number DEE–3439) and Teledyne Laars Co. (case number DEE–3950) correctly pointed out that the water flow rate adjustments called for in section 2.5.4 of the existing Appendix N are inappropriate for low water volume finned tube boilers. Finned tube boilers are designed to raise the water temperature by a maximum of 40°F in order to prevent flashing of water into steam as it passes through the boiler; however, the present section 2.5.4 requires the water flow rate through the boiler to be adjusted to raise the water temperature by 120 to 165°F. DOE is today proposing to add a definition of finned tube boiler in section 1 of Appendix N, and to include in section 2.5.4 of Appendix N an appropriate water flow rate adjustment for finned tube boilers. Specifically, the proposed rule requires the water flow rate through finned tube boilers to be adjusted to produce a temperature rise of 40°F.

These same two applicants also presented an issue regarding the applicability of existing section 4.7 of Appendix N to finned tube boilers. Section 4.7 provides a conversion factor of 3.3 to relate jacket heat loss as determined in the laboratory to predicted jacket heat loss of a furnace or boiler intended to be installed outdoors. Since finned tube boilers have high temperature combustion gases in direct contact with the jacket wall, the temperature difference across the jacket in the laboratory is nearly the same as the temperature difference across the jacket wall that would be experienced when the unit is installed outdoors. Jacket heat losses, which are proportional to these temperature differences, are therefore not measurably affected by location of these boilers. For this reason DOE agrees that the conversion factor of 3.3 is inappropriate for finned tube boilers designed for outdoor installation. Calculations using the conversion factor appear in section 1.27 and section 4.7 of the existing Appendix N. Today's proposed rule amends both of these calculations to allow the conversion factor to equal unity for finned tube boilers designed for outdoor installation.

3. The determination of blower delay time

Today's proposal would amend the method of determining quantity t^+, blower delay time, in section 3.2.1 of Appendix N, by limiting the measured value of t^+ to a maximum of 13.3 minutes, the length of the representative off-cycle, in order to avoid the anomalous situation possible under the existing provisions, where t^+ could assume values greater than the total amount of time the blower would run if it ran continuously.

4. Determination of draft factors

DOE has been requested by manufacturers of furnaces with induced draft fans to allow the option of performing an additional test to determine the values of draft factors in lieu of using the assigned values of draft factors from Tables 1 and 2 of Appendix N. An optional procedure for determining draft factors presently appears in section 3.6 of Appendix N which was intended by DOE to apply to power burner furnaces with induced draft fans, although its applicability does not appear to have been recognized within the furnace industry. DOE is proposing to clarify section 3.6 by expressly stating its applicability to induced draft or forced draft furnaces.

Some representatives of the furnace industry requested that the option of performing the procedure specified in 3.6 of Appendix N for determining draft factors be allowed for non-power burner furnaces, whereas currently this procedure is limited to power burner systems. These commenters contended that some furnace models exhibited draft characteristics which warrant a flue draft factor lower than that assigned in the test procedures ($D_t = 1$).

The optional procedure was specifically designed to evaluate the draft characteristics of furnaces equipped with power burners, and DOE has not yet determined whether the optional procedure is applicable to non-power burner furnaces. DOE is soliciting comments on the applicability of the optional procedure to all types of furnaces, and is particularly interested in learning of any difficulties or inaccuracies encountered by those currently using the optional procedure. In addition, NBS is currently investigating the applicability of the optional procedure to non-power burner furnaces. If this investigation reveals a need for specifying an optional procedure for non-power burner furnaces, NBS will develop such a procedure.

An application for exception (case number DEE–5955) filed with OHA by the Heil-Quaker Company requested that the tables of assigned draft factors (Tables 1 and 2 of Appendix N) be expanded to accomodate a particular furnace employing an induced draft fan with no means of draft relief. The assigned draft factors, as discussed above, are used in lieu of performing the optional procedure in section 3.6 to determine actual draft factors. OHA granted an exception to Heil-Quaker which allowed the use of assigned values of draft factors specifically determined by NBS to be appropriate to the particular basic model in that case. DOE is today proposing to make NBS' recommendations in the Heil-Quaker case generally applicable to all furnaces of similar design characteristics. Accordingly, proposed section 4.4 provides that these additional optional draft factors may be used in testing any forced draft or induced draft furnace which utilizes indoor air for combustion and which has no means of draft relief (i.e., has a direct exhaust system). A definition of "direct exhaust system" is proposed to be added in section 1.34 of Appendix N.

5. Jacket heat losses for electric furnaces

In the existing test procedures for furnaces there is no provision for measuring jacket heat losses for electric furnaces which are intended for outdoor installation. Since the time of prescribing the final rule, DOE has learned of the existence of such furnaces and is therefore proposing to prescribe the same method of measuring jacket heat losses for electric furnaces as is currently prescribed for gas furnaces, by including electric furnaces in the provisions of section 3.4 of Appendix N.

6. Repeatable test data

An application for exception (case number DEE–2129) filed with OHA by Wylain, Inc., alleged that the applicant could not obtain repeatable readings for temperature and percent CO_2 concentration of the stack gases of a particular gas boiler when tested according to the provisions of section 3.1 of Appendix N. OHA granted an exception for that particular boiler, specifying modified testing procedures which would allow the applicant to obtain repeatable data.

DOE is today proposing to allow the modifications specified in that exception to be applied, at manufacturers' option, to all furnaces and boilers. Specifically, the proposed modifications are that the manufacturer would have the option, in proposed section 2.6.1, of using a temperature measuring grid consisting of 17 thermocouples in lieu of the presently prescribed 9 thermocouples, and that the manufacturer would have the option, in proposed sections 3.1.1, 3.1.2, and 3.1.3, of measuring the CO_2 concentration at a location downstream of the plane of temperature measurement in lieu of the presently prescribed location at the plane of temperature measurement. DOE believes these proposed modifications will serve to eliminate any problems regarding nonrepeatable test data, without compromising the reliability of measures of energy consumption derived from the test procedures.

7. Insulation on flue pipes during testing

The existing test procedures do not require any insulation of exposed areas of flue pipes when testing furnaces which employ draft hoods. DOE has received comments indicating that these exposed areas of flue pipe can be substantial in some models of furnaces. Heat loss through these pipes would lead to low estimates of flue losses and thereby jeopardize the accuracy of the measures of energy consumption derived from the test procedure. For this reason, DOE is proposing a provision, in section 2.2.1.2 of Appendix N, to require insulation of the flue pipe upstream of the draft hood when the units are tested.

8. Measures of furnace efficiency

Some members of the furnace industry have recommended that DOE amend the test procedures in order to specify a measure of efficiency which would take into account the energy consumption of the electrical components of fossil fueled furnaces. The present measure of efficiency for such furnaces reflects only the efficiency with which a fossil fueled furnace utilizes its primary fuel, *i.e.* home heating oil, natural gas, or propane. This measure of efficiency is termed the "annual fuel utilization efficiency" (AFUE), and is essentially the ratio between the heat output obtained from the fossil fuel input, and the energy content of the fossil fuel input.

Most fossil fueled furnaces consume some electricity, in addition to primary fuel consumption, in order to power electrical motors needed for air or water circulation. As a consequence of electrical motor inefficiency, however, a furnace equipped with an inefficient motor may consume more electricity than would be necessary solely for purposes of circulating air or water. Any electricity consumption attributable to motor inefficiency, rather than being entirely lost, would be reduced to heat, which typically would find its way into the air distribution system of a furnace. Accordingly, the heat produced by electrical components yields a marginal corresponding reduction in consumption of a furnace's primary fuel. This is reflected in the existing test procedure's calculation of burner operating hours.

Viewed in these terms, the electrical motor energy consumption of a furnace would be 100 percent efficient at point of use, and any measure of efficiency which accounted for electrical energy input and output in this manner would show an efficiency somewhat greater than the AFUE. Such a measure of efficiency would actually encourage the use of inefficient electrical components in fossil fueled furnaces, because primary fuel utilization efficiency is less than 100 percent. Because of the significantly higher unit cost of electricity and inefficiency in the generation and transmission of electricity, such a measure of efficiency would serve neither the consumer's interest nor the nation's need to conserve energy. On the other hand the present AFUE, because it ignores electrical energy consumption altogether, fails to encourage replacement of inefficient electric motors with more efficient motors.

Accordingly, DOE has sought to develop a new efficiency measure which will reflect variations in electrical energy consumption without encouraging the use of inefficient electrical components. One method which has been suggested to DOE would measure electrical energy use of a furnace at the point of generation, rather than at the point of use. DOE has rejected this method because the definitions of "energy efficiency" and "energy use" in section 321(a) of the Act specifically require energy use to be determined at the point of use.

The alternative measure of efficiency proposed to be adopted by DOE is the "energy factor" as calculated in proposed section 4.15. Like the AFUE, as explained above, the energy factor is a ratio whose numerator is the heat output obtained from the fossil fuel input. The energy factor differs from the AFUE only in that the denominator of the energy factor includes the total energy input to a fossil fuel furnace, including electricity, while the denominator of the AFUE includes only the primary fuel input. This approach has the distinct advantage of precluding the anomalous situation in which the use of inefficient electrical motors could be encouraged by DOE test procedures.

9. Room air temperature measurement

The existing test procedures do not prescribe a detailed method of

measuring test room air temperature (T_{RA}). DOE has received comments indicating that under the existing procedures the measured room air temperature may vary due to differences in air temperature at various locations in the test facility. Since the measured room air temperature is used as the combustion air temperature throughout the test calculations, this variability could affect the accuracy of the results of the test procedure. In order to avoid this problem, DOE is proposing to expand the provisions of existing section 2.9 of Appendix N by including specific instructions for locating instruments used for measuring room air temperature, to insure that combustion air temperatures are uniformly and consistently measured throughout the furnace industry.

10. Nameplate input rating

Many manufacturers have objected to the manner in which the rate of gas input is required to be adjusted in section 3.1 of the existing test procedures. The test procedures call for initial adjustment of the gas input rate of gas fueled burners to within 2 percent of the hourly Btu rating specified by the manufacturer (nameplate input rating), measured after 15 minutes of operation starting with all parts of the furnace at room temperature. Subsequent provisions in this section require that the measured input rate, termed Q_{in}, be measured after steady state conditions have been achieved, typically 30 minutes after the burners have been initially adjusted. Section 4.7 specifies that this measured input rate, Q_{in}, is to be used with the steady state efficiency in calculations for determining furnace capacity. Manufacturers noted that Q_{in}, due to the increase in temperature of the furnace parts, is typically lower than the initially adjusted gas input rate. The existing test procedures therefore may require that capacity be determined at an input rate different from the nameplate input rating. Consequently, consumers and others would likely be confused because there would be no logical relationship between the nameplate input rating, capacity, and steady state efficiency. For instance a 100,000 Btu input furnace with a rated output of 80,000 Btu could have a steady state efficiency greater than 80 percent. DOE is proposing to modify section 2.4.1 of Appendix N to require that fuel input rate, Q_{in}, be within 2 percent of nameplate input rating after steady state conditions have been attained.

As noted above, capacity in the existing test procedures is the product of steady state efficiency and the measured input rate, Q_{in}. Due to the fact that under the proposed rule, Q_{in} may vary ±2 percent of the nameplate input rating, variation in the derived capacity can be expected. Manufacturers have suggested that in order to reduce variations, the calculation for determining capacity should be based on the nameplate input rating instead of Q_{in}. DOE agrees with this suggestion and is proposing to use nameplate input rating in the calculation of capacity (Q_{out}) in section 4.7 of Appendix N. These proposed modifications allow for more uniform measures of capacity without reducing testing accuracy.

11. Definitions

DOE is proposing to amend the definition of furnace in section 430.2 in order to more clearly define the applicability of the furnace test procedures by including the words "utilizing single-phase electric current." This will have the effect of excluding from coverage some basic models using three-phase electric current that would otherwise be covered by the test procedures, but which are intended primarily for commercial applications.

DOE is also modifying the definition of furnace in order to exclude from coverage those packaged combination heating and cooling units which are manufactured as a single unit and whose cooling capacity exceeds 65,000 Btu's/hour. A packaged combination unit is a central air conditioner and a furnace in a single cabinet. Although this type of equipment is generally used in commercial applications, either the heating capacity or the cooling capacity of a given model could be within the limits set forth in the central air conditioner or furnace definitions in 10 CFR 430.2. If both heating and cooling capacities of a packaged combination unit fall within the defined limits, the unit is accurately characterized as a residential unit and the DOE test procedures are applicable to both the heating and cooling functions. If either of the functions, however, has a capacity greater than the defined residential limits specified in section 430.2, the unit is most likely to be used in a commercial application and is not covered by the test procedures in either the heating or cooling mode. DOE has modified the definition of furnace in section 430.2 to clarify the treatment of these units in today's proposal.

In addition, DOE is proposing to modify the definition of furnace in order to clarify that the furnace test procedures are presently intended to apply exclusively to furnaces which utilize only electricity, or electricity in conjunction with either natural gas, propane, or home heating oil. The need for this clarification was raised in a petition to OHA by Oneida, Inc., (case number DEE–4101), a manufacturer of furnaces designed to utilize wood as the primary fuel, but which may utilize oil or gas as a backup system. Today's proposal would clarify that such furnaces are not covered by the DOE test procedures.

12. Commercial Standards

Today's notice proposes to incorporate as part of the test procedures the Amercian National Standards Institute (ANSI) standard Z21.47–1978 in lieu of ANSI Z21.47–1973, which is cited in the existing test procedures. DOE has determined that the expanded list of static pressure ranges specified in the new standard will enable the test procedures to yield more accurate results.

Pursuant to section 301 of the Deparment of Energy Organization Act (Pub. L. 95–91), DOE is required to comply with section 32 of the Federal Energy Administration Act of 1974 (FEA Act) (Pub. L. 93–275), as amended by section 9 of the Federal Energy Administration Authorization Act of 1977 (Pub. L. 95–70).

Sections 32 (a) and (b) of the FEA Act provide that:

(a) If any proposed rule by the Administrator contains any commercial standards, or specifically authorizes or requires the use of any such standards, then any general notice of the proposed rulemaking shall—

(1) Identify, by name, the organization which promulgated such standards; and

(2) State whether or not, in the judgment of the Administrator, such organization complied with the requirements of subsection (b) in the promulgation of such standards.

(b) An organization complies with the requirements of this subsection in promulgating any commercial standards if—

(1) It gives interested persons adequate notice of the proposed promulgation of the standards and an opportunity to participate in the promulgation process through the presentation of their views in hearings or meetings which are open to the public;

(2) The membership of the organization at the time of the promulgation of the standards is sufficiently balanced so as to allow for the effective representation of all interested persons;

(3) Before promulgating such standards, it makes available to the public any records or proceedings of the organization, and any documents, letters, memorandums, and materials relating to such standards; and

(4) It has procedures allowing interested persons to—

(A) Obtain a reconsideration of any action taken by the organization relating to the promulgation of such standards, and

(B) Obtain a review of the standards (including a review of the basis or adequacy of such standards).

The findings required of DOE by section 32 of the FEA Act serve to alert the public and DOE to the use and background of commercial standards in a proposed rulemaking and, through the comment and hearing process, allow interested persons to make known their views regarding the appropriateness of the use of particular commercial standards in any proposed rulemaking.

As previously noted, today's notice proposes to change the citation of ANSI Z21.47–1973 to ANSI Z21.47–1978. This updated version of the same standards, as already noted, contains a different list of static pressure ranges from the standard originally cited, and DOE has therefore reevaluated this commercial standard with regard to compliance with section 32(b). It is the judgment of DOE that ANSI Z21.47–1978 does not comply with the requirements of section 32(b), in that the standard was not developed in a manner which provided for public participation, comment, and review. As required by section 32(c) of the FEA Act, DOE will consult with the Attorney General and the Chairman of the Federal Trade Commission prior to prescribing any final rule incorporating the commercial standard.

13. Boiler jacket heat losses

One commenter contended that the existing test procedures for boilers do not accurately reflect actual variations in the seasonal performance attributable to jacket heat losses. The commenter felt that this variation in seasonal performance could be more accurately characterized when an "input/output" type of test procedure is used. As already explained in the discussion pertaining to pulse combustion and condensing furnaces, the present DOE test procedures employ the "flue loss" method of measurement rather than the "input/output" method, in order to simplify laboratory conditions and minimize test burden. The "input/output" method assumes that jacket heat losses are not useful for space heating purposes, while the "flue loss" method assumes that jacket heat losses are useful for space heating purposes.

DOE does not presently have sufficient information to determine that the change suggested by this commenter would result in any increase in test procedure accuracy. DOE has directed NBS to investigate this issue further. Until that investigation is completed, DOE has determined, on the basis of available information, that the existing test procedures are sufficiently accurate for purposes of this program. Accordingly, DOE is not presently proposing to change the existing test procedures regarding the treatment of jacket heat losses.

14. Miscellaneous

After careful consideration of all the comments received in response to the advance notice of proposed rulemaking, and consultation with the National Burea of Standards, DOE has proposed some editorial and minor technical changes that were not discussed above and has incorporated them in the rule proposed today.

C. Number of Units to be Tested

On April 6, 1979, DOE issued a final rule regarding the sampling requirements of consumer products test procedures (44 FR 22410, April 13, 1979) which amended test procedures for 12 types of consumer products, including furnaces, in order to prescribe sampling provisions applicable to testing required under sections 323(c) or 324 of the Act. Those provisions relate specifically to representations regarding the energy consumption of or cost of energy consumed by the various products, and to the labeling of products with any energy consumption information required by the Federal Trade Commission (FTC).

The rule provided that the annual fuel utilization efficiency, energy consumption and estimated annual operating cost of sectional cast-iron boilers (i.e., cast-iron boilers consisting of an assembly of two end sections and a variable number of identical intermediate sections, the number of intermediate sections depending on the desired heating capacity) can be determined by linear interpolation based on data obtained from units having the smallest and largest number of intermediate sections. Alternatively, a manufacturer may determine measures of energy consumption for sectional cast-iron boilers having any number of intermediate sections by actually testing all sizes of such units. Linear interpolation is permitted where a consistent geometry exist through a group of sectional cast-iron boilers. Linear interpolation is inappropriate, and tests are required, whenever irregular geometries exist through a group, or changes occur such as addition or omission of baffles, changes in design of intermediate sections, or changes in fire box dimensions. The final sampling rule contained these provisions at section 430.23(n).

Subsequently, DOE has received comments suggesting that measures of energy consumption for forced air furnaces whose heat exchangers consist of a variable number of identical sections, the number of sections depending on the desired heating capacity, can be accurately determined by calculations based on the measures of energy consumption found from other such furnances actually tested.

In addition, commenters have indicated that furnaces with sectional heat exchangers and identical input, which differ only in configuration (counterflow, upflow), often exhibit measures of energy consumption which are nearly identical. These commenters have requested a modification to the sampling plan in order to reduce the number of basic models required to be tested.

Neither DOE nor any commenter has yet devised acceptable criteria for identifying those furnaces with sectional heat exchangers for which calculations or other non-testing methods can be shown to yield accurate measures of energy consumption. Accordingly, today's notice does not propose any changes to the test procedures sampling requirements. DOE will continue to evaluate this issue and is interested in receiving further comments to assist DOE's evaluation. Specifically, DOE invites comments on criteria which may be used to identify in a subsequent proposal those groups of furnaces with sectional heat exchangers for which measures of energy consumption for certain basic models can acceptably be determined by calculation or other non-testing methods. For the convenience of interested persons, today's proposed rule reprints the furnace sampling provision, 10 CFR 430.23(m).

D. Comment Procedure

1. Written Comment

Interested persons are invited to participate in this rulemaking by submitting data, views or arguments with respect to the proposed amendments set forth in this notice.

Comments should be identified on the outside of the envelope and on documents submitted to DOE with the designation "Furnaces—Proposed Amendments (Docket #CAS–RM–79–104)." Fifteen copies should be submitted if possible. All comments received by [60 days from publication], and all other relevant information, will be considered by DOE before final action is taken on the proposed regulation. Pursuant to the provisions of 10 CFR 1004.11, any person submitting information which he or she believes to be confidential and exempt by law from public disclosure should submit one complete copy, and fifteen copies from which information claimed to be confidential has been deleted. In accordance with the procedures

established at 10 CFR 1004.11, DOE shall make its own determination with regard to any claim that information submitted be exempted from public disclosure.

2. Public Hearing

a. *Request Procedure.*—The time and place of the public hearing are indicated at the beginning of this preamble. The hearing will be continued, if necessary, on the following day. DOE invites any person who has an interest in today's proposed amendments, or who is a representative of a group or class of persons that has an interest in today's proposed amendments, to make a written request for an opportunity to make an oral presentation. Such a request should be directed to the address indicated at the beginning of this preamble and must be received before February 13, 1980. Such a request may be hand delivered to such address, between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday. A request should be labeled both on the document and on the envelope "Furnace Test Procedures—Proposed Amendments (Docket #CAS–RM–79–104)."

The person making the request should briefly describe the interest concerned; if appropriate, state why he or she is a proper representative of a group or class of persons that has such an interest, and give a concise summary of the proposed oral presentation and a telephone number where such person may be contacted.

DOE will notify each person selected to appear at the hearing. Each person selected to be heard should submit 15 copies of his statement to the address and by the date given in the beginning of this preamble. In the event any person wishing to testify cannot meet the 15 copy requirement, alternative arrangements can be made with Carol A. Snipes in advance of the hearing by so indicating in the letter requesting an oral presentation or by calling (202) 376–1651.

b. *Conduct of Hearing.*—DOE reserves the right to select the persons to be heard at the hearing, to schedule their respective presentations, and to establish the procedures governing the conduct of the hearing. The length of each presentation may be limited, based on the number of persons requesting to be heard.

A DOE official will be designated to preside at the hearing. This will not be a judicial or evidentiary type hearing. Questions may be asked only by those conducting the hearing, and there will be no cross-examination of persons presenting statements. Any decision made by DOE with respect to the subject matter of the hearing will be based on all information available to DOE. At the conclusion of all initial oral statements, each person who has made an oral statement will be given the opportunity, if she or he so desires, to make a rebuttal statement. The rebuttal statements will be given in the order in which the initial statements were made and will be subject to time limitations.

Any interested person may submit questions to be asked of any person making a statement at the hearing. DOE will determine whether the question is relevant, and whether the time limitations permit it to be presented for answer.

Any further procedural rules needed for the proper conduct of the hearing will be announced by the presiding officer.

A transcript of the hearing will be made and the entire record of the hearing, including the transcript, will be retained by DOE and made available for inspection at the DOE Freedom of Information Office in the Forrestal Building, Independence Avenue and L'Enfant Plaza, S.W., Washington, D.C. 20585, between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday. In addition, any person may purchase a copy of this transcript from the reporter.

E. Regulatory and Environmental Review

Pursuant to Section 7(c)(2) of the Federal Administration Act of 1974, a copy of this notice has been submitted to the Administrator of the Environmental Protection Agency for his comments concerning the impact of this proposal on the quality of the environment. The Administrator has no comments.

In accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA) 42 USC 4321 *et seq.*, DOE has evaluated the proposed establishment of these testing procedures for consumer products to determine if an environmental assessment (EA) or an environmental impact statement (EIS) is required. These test procedures will be used only to standardize the measurement of energy usage for the subject consumer products. The action of prescribing these test procedures, by itself, will not result in any environmental impacts. Since it is thus clear that the proposed action is not a major Federal action significantly affecting the quality of the human environment, DOE has determined that neither an EA nor an EIS is required. The potential environmental impacts that might occur from the application of the test procedures in connection with DOE's minimum energy efficiency standards program will be evaluated by that program.

The proposed rule has been reviewed in accordance with Executive Order 12044 and DOE Order 2030, and it has been determined that the proposal was significant in nature but does not have major impacts to manufacturers and consumers (i.e., would not impose annual economic costs of $100 million or more).

(Energy Policy and Conservation Act, Pub. L. 94–163, as amended by Pub. L. 94–619; Department of Energy Organization Act, Pub. L. 95–91; E.O. 12009, 43 F.R. 46267)

In consideration of the foregoing, it is proposed to amend Chapter II of Title 10, Code of Federal Regulations, as set forth below.

Issued in Washington, D.C., December 26, 1979.

Maxine Savitz,

Acting Assistant Secretary, Conservation and Solar Energy.

1. Section 430.2 is amended by revising the definition of "furnace" to read as follows:

§ 430.2 Definitions.

* * * * *

"Furnace" means a device, utilizing only single-phase electric current, or single-phase electric current in conjunction with either natural gas, propane, or home heating oil, which is designed to be the principal heating source for the living space of a residence and which is not contained within the same cabinet with a central air conditioner whose rated cooling capacity is above 65,000 Btu's per hour. Every furnace is either an electric central furnace, electric boiler, forced-air central furnace, gravity central furnace, or low pressure steam or hot water boiler. The heat input rate of a furnace is less than 300,000 Btu's per hour for electric boilers and low pressure steam or hot water boilers, and is less than 225,000 Btu's per hour for forced-air central furnaces, gravity central furnaces, and electric central furnaces.

* * * * *

2. Section 430.22 is amended by redesignating the present paragraph (n)(4) as paragraph (n)(5) and by adding a new paragraph (n)(4) to read as follows:

§ 430.22 Test procedures for measures of energy consumption.

* * * * *

(n) *Furnaces.* * * *

(4) The energy factor for fossil-fueled furnaces, expressed in percent, is the ratio of annual output of useful energy delivered to the heated space to the

total annual energy input to the furnace determined according to 4.15 of Appendix N of this subpart.

* * * * *

3. The provisions of § 430.23 which relate to furnaces are reprinted as follows for the convenience of the reader:

§ 430.23 Units to be tested.

When testing of a covered product is required to comply with section 323(c) of the Act or to comply with rules prescribed under section 324 of the Act, a sample shall be selected and comprised of units which are production units, or are representative of production units of the basic model being tested, and shall meet the following applicable criteria.

* * * * *

(n)(1) For each basic model[2] of furnaces, other than basic models of those sectional cast-iron boilers which may be aggregated into groups having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the annual fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(2) For the lowest capacity basic model[2] of a group of basic models of those sectional cast-iron boilers having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) Any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .95.

(3) For the highest capacity basic model[2] of a group of basic models of those sectional cast-iron boilers having identical intermediate sections and combustion chambers, a sample of sufficient size shall be tested to insure that—

(i) any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values be no less than the higher of (A) the mean of the sample, or (B) the upper 97½ percent confidence limit of the true mean divided by 1.05, and

(ii) Any represented value of the fuel utilization efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (A) the mean of the sample, or (B) the lower 97½ percent confidence limit of the true mean divided by .05.

(4) For basic model[2] or capacity other than the highest or lowest of the group of basic models [2] of sectional cast-iron boilers having identical intermediate sections and combustion chambers, represented values of measures of energy consumption shall be determined by either—

(i) A linear interpolation of data obtained for the smallest and largest capacity units of the family, or

(ii) Testing a sample of sufficient size to insure that (A) any represented value of estimated annual operating cost, energy consumption or other measure of energy consumption of a basic model for which consumers would favor lower values shall be no less than the higher of (1) the mean of the sample, or (2) the upper 97½ percent confidence limit of the true mean divided by 1.05, and (B) any represented value of the energy factor or other measure of energy consumption of a basic model for which consumers would favor higher values shall be no greater than the lower of (1) the mean of the sample, or (2) the lower 97½ percent confidence limit of the true mean divided by .95.

(5) Whenever measures of energy consumption determined by linear interpolation do not agree with measures of energy consumption determined by actual testing, the values determined by testing will be assumed to be the more reliable values.

(6) In calculating the measures of energy consumption for each unit tested, use the design heating requirement corresponding to the mean of the capacities of the units of the sample.

4. Section 1.18 of Appendix N to Subpart B is amended to read as follows:

1.18 "Steady state heat input" (Q_{in}) means the rate of energy supplied in a fuel to a furnace, operating under steady state conditions, expressed in Btu's per hour. It includes any input energy to the pilot light and is obtained by multiplying the measured rate of fuel consumption by the measured higher heating value of the fuel.

5. Section 1.27 of Appendix N to Subpart B is amended to read as follows:

1.27 "Heating capacity" (Q_{out}) means the rate of useful heat output from a furnace, operating under steady state conditions, expressed in Btu's per hour. For furnaces intended to be installed indoors, it is obtained by multiplying the "nameplate input" by the steady state efficiency (n_{ss}) divided by 100. For furnaces intended to be installed outdoors, it is obtained by multiplying (A) the "nameplate input" by (B) the difference of the steady state efficiency divided by 100 and the quantity (3.3) (L_j) divided 100, where L_j is the jacket loss as determined in 3.4 of this appendix. For finned tubed boilers intended to be installed outdoors, it is obtained by multiplying (A) the "nameplate input rating" by (B) the difference of the steady state efficiency divided by 100 and the quantity L_j divided by 100, where L_j is the jacket loss as determined in 3.4 of this appendix.

6. Appendix N to Subpart B is amended by adding, after § 1.27, the following new sections:

1.28 "Condensing furnace" means a furnace or boiler which condenses part of the water vapor generated by the burning of hydrogen in fuels and is equipped with a means of collecting and draining this condensate. A furnace or boiler shall be considered a "condensing furnace" only if the latent heat loss coefficient (C_L), defined in 1.29 below, is less than 1.

1.29 "Latent heat loss coefficient (C_L)" means the coefficient which is the fraction of the total latent heat remaining in the flue gases after any condensing has occurred, as calculated in section 4.17 of this appendix.

1.30 "Pulse combustion furnace" means a furnace or boiler which uses a steady sequence of explosions to produce heat.

1.31 "Nameplate input rating" means the maximum hourly Btu input rate affixed by the manufacturer to a fossil-fueled furnace to indicate the fuel burning capacity.

1.32 "Finned tube boiler" means a boiler whose heat exchanger consists of only finned tubes.

1.33 "Forced draft" means air forced into the combustion chamber by mechanical means.

1.34 "Direct exhaust system" means a furnace venting system supplied by the manufacturer through which the products of

[2] Components of similar design may be substituted without requiring additional testing if the represented measures of energy consumption continue to satisfy the applicable sampling provision.

combustion pass directly from the furnace to the outside and which does not employ a means of draft relief.

7. Section 2.1.3 of Appendix N to Subpart B is amended to read as follows:

2.1.3 Low pressure steam and hot water boilers (including direct vent systems). Install gas-fueled low pressure steam and hot water boilers as prescribed in section 2.9 of ANSI Standard Z21.13–1974. Install oil-fueled low pressure steam and hot water boilers as prescribed in sections 7.0 and 8.1.1 through 8.1.3 in the January 1977 edition of the Hydronic Institute "Testing and Rating Standard for Cast Iron and Steel Heating Boilers." In the case of condensing boilers, a means shall be provided for supplying 120° F return water, at a constant rate, to the test boiler during both the steady state and heat-up tests described below. This will typically, although not necessarily, require the use of a large tank, an auxiliary boiler and two pumps.

8. Section 2.2.1.2 of Appendix N to Subpart B is amended to read as follows:

2.2.1.2 Gas-fueled gravity and forced-air central furnaces which employ draft hoods. Test gas-fueled gravity and forced-air central furnaces which employ draft hoods having vertically discharging outlets with the draft hood in place and a 5-foot long pipe attached to the hood outlet. Test gas-fueled furnaces having a horizontally discharging hood outlet, with the draft hood in place and an insulated elbow and a 5-foot long vertical pipe attached to the hood outlet. Insulate the flue pipe and elbow upstream of the draft hood with insulation having an R value not less than 7 (° F–HR–ft ^{2}/Btu's) and an outer layer of aluminum foil. Use an elbow and pipe with a cross sectional area the same size as the hood discharge outlet.

9. The first sentence of section 2.2.3 of Appendix N to Subpart B is amended to read as follows:

2.2.3 Direct vent and direct exhaust systems.

10. Section 2.4.1 of Appendix N to Subpart B is amended to read as follows:

2.4.1 Gas burner adjustments (not including condensing furnaces). Adjust burners of gas-fueled furnaces or boilers such that the Btu's per hour input, as measured during the steady state performance test described below and corrected to standard conditions of 60° F and 30 inches of mercury barometric pressure, is within ± 2 percent of the nameplate input rating. Set the primary air shutters in accordance with the manufacturer's recommendation to give a good flame at this adjustment. If, however, the setting results in the deposit of carbon during any test specified herein, the tester shall adjust the shutters and burners until no more carbon is deposited and shall perform the tests again with the new settings. After the steady state performance test has been started, do not make additional adjustments to the burners during the required series of performance tests specified in section 3.0 of this appendix.

If a vent limiting means is provided on a gas pressure regulator, keep it in place during all tests.

11. Section 2.4.2 of Appendix N of Subpart B is amended to read as follows:

2.4.2 Oil burner adjustments (not including condensing furnaces). Adjust the burners of oil-fueled furnaces or boilers to give the CO_2 reading recommended by the manufacturer and an hourly Btu input during the steady state performance test described below which is within ± 2 percent of the furnace nameplate input rating. Smoke in the flue may not exceed a No. 1 smoke during the steady state performance test as measured by the procedure in ANSI Standard Z11.182–1965 (R1971) (American Society for Testing and Materials D 2156–65 (1970)). Maintain the average draft over the fire and in the flue during the steady state performance test at that recommended by the manufacturer. Do not allow draft fluctuations exceeding 0.005 inches of water gauge. Do not make additional adjustments to the burner during the required series of performance tests. The instruments and measuring apparatus for this test are described in section 6.3 of ANSI Standard Z991.1–1972.

12. Appendix N to Subpart B is amended by adding, after section 2.4.2, the following new section:

2.4.3 Gas and oil burner adjustments for condensing furnaces. The burners on gas- and oil-fueled condensing furnaces and boilers shall be adjusted to give, during the steady state performance test described below, the CO_2 reading recommended by the manufacturer (if applicable) and an hourly Btu input which is within ± 2 percent of the nameplate input rating. During the steady state performance test, the concentration of carbon monoxide present in dry flue gas shall not exceed 0.04 percent by volume. For oil-fired condensing units, the smoke in the flue gases shall not exceed a No. 1 smoke during the steady state performance test as measured by the procedure in ANSI Standard Z11.182–1965 (R 1971) (ASTM D2156–65 (1970)). If the carbon monoxide or smoke exceeds these specified limits during the steady state test, the burner shall be readjusted to give a lower CO_2 reading and all tests shall be started over. Once the burner is properly adjusted, no additional adjustments shall be made to it during the required series of performance tests.

If a vent-limiting means is provided on a gas pressure regulator, it shall be in place during all tests.

13. Section 2.5.1 of Appendix N to Subpart B is amended to read as follows:

2.5.1 Gas-fueled forced-air central furnaces (including direct vent systems and condensing furnaces). Adjust the external static pressure and air flow rate as specified in ANSI Standard Z21.47–1978. Measure outlet air temperature in accordance with section 2.19 of the same standard.

For gas-fueled condensing furnaces, the temperature rise during the steady state tests described below shall not be less than 50° F. During the steady state and heat-up tests described below, the return air temperature to the condensing furnace shall remain within ± 5° F of the value T_{RA} measured during the steady state performance test.

14. Section 2.5.3 of Appendix N to Subpart B is amended to read as follows:

2.5.3 Oil-fueled forced-air central furnances (includingdirect vent systems and condensing furnances). Adjust the external static pressure and air flow rate as specified in table 5 and section 6.2 of ANSI Standard Z91.1–1972. For oil fueled condensing furnances, the temperature rise during the steady state tests described below shall not be less than 50°F. During the steady state and heat-up tests described below, the return air temperature to the condensing furnance shall remain within ±5°F of the value T_{RA} measured during the steady state performance test.

15. Section 2.5.4 of Appendix N to Subpart B is amended to read as follows:

2.5.4 Gas- and oil-fueled low pressure steam and hot water boilers (including direct vent systems and condensing boilers). For hot water boilers, adjust the water flow rate to produce a water temperature rise, during steady state operation, of between 120°F (48.9°C) and 165°F (73.9°C) and an outlet water temperature of 200°F (93.3°C) ±5°F (2.8°C). For finned tube boilers, the water flow shall be adjusted to produce a temperature rise of 20 to 40°F and outlet water temperature of 200°F ±5°F. Also for finned tube boilers, the maximum permissible temperature variation of the return water is limited to 5°F. For steam boilers, conduct the steady state performance test described in 3.1 at atmospheric pressure or at a pressure not exceeding 2 psia.

For condensing hot water boilers, the water flow rate shall be adjusted to produce a water temperature rise, during the steady state test described below, which is between 19.5 and 20.5°F. During the steady state and heat-up tests, the condensing boiler shall be supplied with return water having a temperature of 120°F. The maximum permissible variation of the return water temperature from the required value during the steady state and heat-up tests shall not exceed ±2°F, except during the first 30 seconds after start-up when it shall not exceed ±10°F, and between 30 and 60 seconds after start-up it shall not exceed ±5°F.

16. Section 2.6.1 of Appendix N to Subpart B is amended to read as follows:

2.6.1 Gas-fueled gravity furnaces, forced-air furnaces, and boilers (including direct vent systems and condensing furnances and boilers). For units employing an integral draft diverter, install a grid of thermocouples wired in parallel, in a horizontal plane in the 5-foot test stack located 1 foot from the test stack inlet. The grid shall consist of either 9 or 17

thermocouples (manufactuer's option) if the nominal inside diameter of the flue pipe is greater than 2 inches, and 5 thermocouples if the nominal inside diameter of the flue pipe is less than or equal to 2 inches. Henceforth in this section all parenthetical expressions refer to the 17 thermocouple grid, and all bracketed expressions refer to the 5 thermocouple grid. Equalize the length of all thermocouple leads before paralleling. Arrange the thermocouples in a grid with 1 thermocouple in the center of the test stack, and 8 (16) [4] along imaginary lines intersecting at right (45 degree) [right] angles in the horizontal plane at points one-third and two-thirds (one-third and two-thirds) [half] of the distance between the center of the pipe and the pipe wall.

For units which employ a draft hood, or a direct vent system which does not significantly preheat the incoming combustion air, install the thermocouple grid described above in a horizontal plane located within 12 inches (304.8 mm) of the furnance or boiler outlet, and upstream of the draft hood on units so equipped. Equalize the length of all thermocouple leads before paralleling and arrange the thermocouples as described above.

For furnances or boilers which employ direct vent systems that significantly preheat the incoming combustion air, install the thermocouple grid described above in a plane parallel to and located within 6 inches (152.4 mm) of the vent/air intake terminal. Equalize the length of all thermocouple leads before paralleling and arrange the thermocouples as described above.

Use bead-type thermocouples having wire size not greater than No. 24 AWG. If there is a possibility that the thermocouples could receive direct radiation from the flame, install radiation shields on the flame side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Locate the termocouples used for measuring conditioned warm air as described in ANSI Z21.47–1978, sections 2.1.9 and 2.9.1. Measure the temperature of the inlet air by means of a single No. 24 AWG bead-type thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

For non-condensing boilers, measure the inlet and outlet water temperature on gas-fueled hot water boilers as shown in figure 3 of ANSI Standard Z21.13–1974. For condensing boilers, the inlet and outlet water temperatures shall be measured using sheathed thermocouples inserted through pipe plugs that are located within 12 inches of the inlet and outlet of the boiler. A minimum of 6 inches of thermocouple lead, immediately upstream of the thermocouple junction, shall be immersed in the water between the pipe plug and the boiler inlet/outlet. The remainder of the thermocouple lead shall be run along the surface of the pipe (and under any insulation) for a distance of not less than 3 feet. The pipe, 3 feet immediately before the boiler inlet and 3 feet immediately after the boiler outlet, shall be covered with insulation having a R value of not less than 7 (°F-h-ft ²/Btu) and an outer layer of alumimun foil.

17. Section 2.6.2 of Appendix N to Subpart B is amended to read as follows:

2.6.2 Oil-fueled forced-air central furnaces and boilers (including direct vent systems and condensing furnaces and boilers). Install a grid of thermo-couples, wired in parallel and having equal length leads, in a plane perpendicular to the axis of the flue pipe. For systems other than direct vent systems which significantly preheat the incoming air, locate this plane at the position of the single thermocouple shown in figure 2 of ANSI Standard Z91.1–1972. For direct vent systems which significantly preheat the incoming air, locate the plane within 6 inches (152.4 mm) of the outlet of the vent/air intake terminal. Arrange the thermocouples as described in section 2.6.1.

Use bead-type thermocouples having a wire size not greater than No. 24 AWG. If there is a possibility that the thermocouples could receive direct radiation from the flame, install radiation shields on the flame side of the thermocouples only and position the shields so that they do not touch the thermocouple junctions.

Locate the thermocouples for measuring conditioned warm air as described in section 6.2 of ANSI Standard Z91.1–1972. Measure the temperature of the inlet air by means of a single thermocouple, suitably shielded from direct radiation and located in the center of the plane of each inlet air opening.

For non-condensing boilers, measure the inlet and outlet water temperatures on oil-fueled hot water boilers as described in section 7.4 and figure 2 of the January 1977 edition of the Hydronic Institute Standard "Testing and Rating Standard for Cast Iron and Steel Heating Boilers." For condensing oil-fueled boilers, the inlet and outlet water temperature shall be measured as described in 2.6.1 for gas-fueled condensing boilers.

18. Section 2.7 of Appendix N to Subpart B is amended to read as follows:

2.7 *Combustion measurement instrumentation.* Analyze the samples of stack and flue gases for furnaces and determine the concentration by volume of CO_2 present in the dry stack or flue gas with instrumentation which will result in a determination of the CO_2 concentration with an error no larger than ±0.1 percentage points.

19. Section 2.9 of Appendix N to Subpart B is amended to read as follows:

2.9 *Room ambient temperature.* During the time period required to perform all the testing and measurement procedures specified in section 3.0, maintain the room temperature within ±5°F (+2.8 C) of the value T_{RA} measured at the end of the steady state performance test. During these tests, the room temperature may not exceed 100°F (37.8 C) or fall below 65°F (18.3 C). Room temperature (T_{RA}) shall be the arithmetic average temperature of the test area, determined by measurement with four No. 24 AWG iron-constantan bead-type thermocouples with junctions shielded against radiation, located approximately at 90-degree positions on a circle circumscribing the furnace or furnace enclosure under test, in a horizontal plane approximately at the vertical midpoint of the appliance or test enclosure, and with the junctions approximately 24 inches from sides of the furnace or test enclosure and located so as not to be affected by other than room air. The temperature of the air for combustion and the air for draft relief shall not differ more than ±5°F from room temperature as measured above.

20. Section 2.10 of Appendix N to Subpart B is amended to read as follows:

2.10 *Equipment used to measure mass flow rate in flue and stack.* The tracer gas chosen for this task should have a density which is less than or approximately equal to the density of air. Use a gas that is of a different chemical species or different concentration from the flue gas to be measured and unreactive with the environment to be encountered. Using instrumentation of either the batch or continuous type, measure the concentration of tracer gas with an error no larger than ±2 percent of the value of the concentration measured.

21. Section 3.1.1 of Appendix N to Subpart B is amended to read as follows:

3.1.1 Gas-fueled gravity furnaces, forced-air central furnaces, and low pressure steam and hot water boilers (including direct vent systems and not including condensing furnaces, or boilers). The following procedure is to be used for gas-fueled gravity furnaces, forced-air central furnaces, and boilers (including direct vent systems).

Set up the furnace or boiler as specified in sections 2.1, 2.2, and 2.3. Begin the steady state performance test by operating the burner and the circulating air blower or water pump, with the adjustments specified by 2.4.1 and 2.5, until steady state conditions are attained as indicated by a temperature variation in three successive readings taken 15 minutes apart of not more than: (1) 3°F (1.7C) in the stack gas temperature for furnaces and boilers equipped with draft diverters, (2) 5°F (2.8C) in the flue gas temperature for furnaces and boilers equipped with either draft hoods, or direct vent systems, and (3) 4°F (2.2C) in the outlet water temperature for hot water boilers.

On units employing draft diverters, measure the room temperature (T_{RA}) as described in 2.9 and measure the steady state stack gas temperature ($T_{s.ss.x}$) using the thermocouple grid located in the 5-foot test stack as described in 2.6.1. Secure a sample of stack gases in the plane where $T_{s.ss.x}$ is measured, or within 3.5 feet of this plane on the downstream side, and determine the concentration by volume of carbon dioxide ($X_{CO2.s}$) present in dry stack gas. If the location of gas sampling differs from the temperature measurement plane, care should be taken to assure that there are no air leaks in the stack pipe between the two locations.

On units employing draft hoods or direct vent systems, measure the room temperature

(T_{RA}) as described in 2.9 and measure the steady state flue gas temperature ($T_{F,SS,X}$) using the thermocouple grid located in the flue pipe as described in section 2.6.1. Secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of CO_2 ($X_{CO2,F}$) present in dry flue gas. For units employing draft hoods or direct vent units which significantly preheat the incoming combustion air, secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of CO_2 ($X_{CO2,F}$) present in dry flue gas. For direct vent units which do not significantly preheat the incoming combustion air, secure a sample of the flue gas in the plane of temperature measurement, or within 3.5 feet of this plane on the downstream side, and determine the concentration by volume of CO_2 ($X_{CO2,F}$) present in dry flue gas. If the location of gas sampling differs from the temperature measurement plane, care should be taken to assure that there are no air leaks in the flue pipe between the two locations.

Determine the steady state heat imput rate (Q_{in}), including pilot gas, by multiplying the measured higher heating value of the test gas by the steady state gas input rate corrected to standard conditions of 60°F and 30 inches of mercury. Use measured values of gas temperature and pressure at the meter and the barometric pressure to correct the metered gas flow rate to standard conditions.

Measure the steady state electric power to the power burner (PE) on units so equipped. For furnaces, measure thesteady state electrical power to the conditioned air blower (BE). For hot water boilers, use a steady state water pump power of 0.13kW.

After the above test measurements have been completed on units employing integral draft diverters, secure a sample of the flue gases at the inlet to the draft diverter and determine the concentration of CO_2 ($X_{CO2,F}$) present. In obtaining this sample of flue gas, move the sampling probe around to assure that an average value is obtained for the CO_2 concentration. To obtain the average CO_2 concentration for units with multiple heat exchanger outlets, draw and weight a sample from each outlet. Block the draft diverter relief opening and cover the draft diverter and flue gas collection box (on a power vented unit) with insulation having an R value no less than 7 (°F-HR-ft²/Btu) and an outer layer of aluminum foil. If the unit is turned off during the process of blocking the diverter relief opening, run it until steady state conditions (as defined above) are again achieved. Progressively restrict the test stack outlet until the concentration of CO_2 in flue gas samples secured from the test stack in the plane where $T_{S,SS,X}$ was measured is within ±0.2 percentage points of the previously determined value of ($X_{CO2,F}$). Measure the flue gas terperature ($T_{P,SS}$) using the thermocouple grid located in the 5-foot test stack as described in 2.6.1.

22. Section 3.1.2 of Appendix N to Subpart B is amended to read as follows:

3.1.2 Oil-fueled forced-air central furnaces and low pressure steam and hot water boilers (including direct vent systems and not including condensing furnaces or boilers). Set up and adjust the furnace or boiler as specified in sections 2.1, 2.2 and 2.3.4. Begin the steady state performance test by operating the burner and the circulating air blower or water pump with the adjustments specified by 2.4.2 and 2.5 until steady state conditions are attained as indicated by a temperature variation in three successive readings taken 15 minutes apart of not more than: (1) 5°F (2.8C) in the flue gas temperature for furnaces and boilers and (2) 4°F (2.2C) in the outlet water temperature for hot water boilers.

Smoke in the flue for units equipped with power burners may not exceed a No. 1 smoke during the steady state performance test as measured by the procedure described in ANSI Standard Z11.182–1975 (R1971) (ASTM D 2156–65 (1970)). Maintain the average draft (recommended by the manufacturer) over the fire and in the breeching during the steady state performance test. Draft fluctuations may not exceed 0.005 inches of water guage.

Measure the room temperature (T_{RA}) as described in 2.9 and measure the steady state flue gas temperature ($T_{F,SS}$) using the thermocouple grid located in the flue pipe as described in 2.6.1. Secure a sample of the flue gas in the plane of temperature measurement or within 3.5 feet of this plane on the downstream side and determine the concentration by volume of CO_2 ($X_{CO2,F}$) present in dry flue gas. If the location of gas sampling differs from the temperature measurement plane, care should be taken to assure that there are no air leaks in the flue pipes between the two locations.

Measure and record the steady state heat imput rate (Q_{in}) and the steady state electrical power to the power burner (PE) on unit so equipped. For furnaces, measure the steady state electrical power to the conditioned air blower (BE). For hot water boilers, use a steady state water pump power of BE = 0.13 kW.

23. Appendix N to Subpart B is amended by renumbering the present section 3.1.3 as 3.1.4.

24. Appendix N to Subpart B is amended by renumbering the present section 3.1.3 as 3.1.5.

25. Appendix N to Subpart B is amended by adding a new section 3.1.3 to read as follows:

3.1.3 Gas- and oil-fueled condensing furnances and boilers. The furnace or boiler shall be set up as specified in sections 2.1, 2.2, 2.3, and 2.6. Begin the test by operating the burner and circulating air blower or water pump for hot water boilers, with the adjustments specified in 2.4 and 2.5, until steady state conditions are obtained as indicated by a temperature variation in their successive readings taken 15 minutes apart of not more than 1°F (0.56°C) in the flue gas temperature and the supply (outlet) water temperature.

Measure the room temperature (T_{RA}) as described in section 2.9, and measure the steady state flue gas temperature ($T_{F,SS}$) using the thermocouple grid described in section 2.6. A sample of the flue gas shall be secured in the plane of temperature measurement or within 3.5 feet of this plane on the downstream side and analyzed to determine the concentration by volume of CO_2 ($X_{CO2,F}$) present in the dry flue gas. If the location of sampling the CO_2 differs from the temperature measurement plane, care should be taken to assure that there are no air leaks in the flue pipe between these two locations.

The steady state heat imput rate (Q_{in}), including pilot gas input if appropriate, shall be determined by multiplying the measured higher heating value of the test fuel by the measured steady state imput rate. If gas is the fuel used, correct the imput rate to standard conditions of 69°F and 30 inches of mercury using measured values of gas temperature and pressure at the meter and the measured barometric pressure.

Measure the steady electric power to the burner (PE), if appropriate. For furnaces, measure the steady state electrical power to the conditioned air blower (BE). For hot water boilers, use a steady state water pump power of BE = 0.13 kw. Record all measured values.

26. Section 3.2.1 of Appendix N to Subpart B is amended to read as follows:

3.2.1 Gas- and oil-fuel gravity and forced-air central furnaces (including direct vent systems but not including condensing furnaces). Turn off the main burner after steady state testing is completed and measure the flue gas temperature by means of the thermocouple grid described above at 1.5 ($T_{F,OFF}$ (t_s)) and 9.0 minutes ($T_{P,OFF}$ (t_s)) after the burner shuts off. By-pass the damper control in units smploying stack dampers and integral draft diverters or draft hoods so that the damper remains open during the cool down test.

During this off-period, allow a time delay (t^+) between burner shut-down and blower shut-down of either 3 minutes or until the supply air temperature drops to a value of 40° F (22.2° C) above the inlet air temperature, whichever results in the longest blower on-time. However, if the furnace employs a single motor to drive a power burner and an indoor air circulating blower, turn off the blower and the burner together. If the blower delay time exceeds 3 minutes, measure the time delay (t^+) between burner shut-off and blower shut-off using a stop watch. The quantity t^+ shall be set equal to this measured delay time or 13.3 minutes, whichever is smaller. For oil-fueled furnaces not equipped with stack dampers, maintain the draft in the flue pipe within a range of −0.001 and +0.005 inch of water gauge of the average draft maintained during the steady state test described in section 3.1 if the optional test in section 3.6 is being carried out, or within ±0.01 inch of water gauge of the average steady state draft if it is not. For a direct vent system with a flue damper or a furnace equipped with both a stack damper and a barometric damper, close the flue or stack damper during the cool-down test. Keep the main burner(s) off until equilibrium conditions are attained as indicated by variations in the flue gas temperature of not more than 3° F (1.7° C) between three successive readings taken 15 minutes apart. For units employing a continuously burning

pilot light, take a third flue gas temperature measurement and determine the off-period minimum flue gas temperature ($T_{F,\,OFF}(\infty)$). For units not employing a continuously burning pilot light, set ($T_{F,\,OFF}(\infty)$) equal to the room temperature (T_{RA}). During this cool-down test, measure the energy input rate to the pilot light (Q_P), if the unit is so equipped, within an error no larger than ±3 percent. Record all measured values.

27. Section 3.2.2 of Appendix N to Subpart B is amended to read as follows:

3.2.2 Gas- and oil-fueled boilers (including direct vent systems and not including condensing boilers). After steady state testing has been completed, turn the main burner(s) off and measure the flue gas temperature at 3.75 ($T_{F,\,OFF}(t_3)$) and 22.5 ($T_{F,\,OFF}(t_4)$) minutes after the burner shuts off, using the thermocouple grid described above. During this off-period, do not allow water to circulate through the hot water boilers. Make a third flue gas temperature measurement 45 minutes after the burner shuts off to determine the off-period minimum flue gas temperature ($T_{F,\,OFF}(\infty)$). During this cool-down test, measure the energy input rate to the pilot light (Q_P), if the unit is so equipped, to within an error no larger than ±3 percent. Record all measured values. For oil-fueled units not equipped with stack dampers, maintain the draft in the flue within the same ranges called for in section 3.2.1 above. For direct vent systems with flue dampers or boilers equipped with both stack dampers and barometric dampers, close the flue or stack damper during the cool-down test.

28. Appendix N to Subpart B is amended by adding, after section 3.2.2, the following new sections:

3.2.3 Gas- and oil-fueled condensing furnaces. After steady state testing is completed and all required measurements made, the burner shall be turned off and the flue gas temperature measured by means of the thermocouple grid described in section 2.6 at 1.5 ($T_{F,\,OFF}\,t_3$) and 9.0 ($T_{F,\,OFF}\,t_4$) minutes after the burner shuts off. Units employing flue dampers shall have their dampers closed during the cool-down test. During this off-period, there shall be a time delay (t^+) between burner shut down and blower shut-down of either 1.5 minutes or until the supply air temperature drops to a value of 40° F (22.2° C) above the inlet air temperature, whichever results in the larger blower on-time. An exception to this is if the furnace employs a single motor to drive a power burner and an indoor air circulating blower, the blower and the burner shall be shut off together. If the blower delay time exceeds 1.5 minutes, the time between burner shut-off and blower shut-off shall be measured using a stop watch and the quantity t^+ shall be set equal to this measured delay time or 13.3 minutes, whichever is smaller. For units equipped with a continuously burning pilot light, the main burner(s) shall remain off until equilibrium conditions are attained as indicated by variations in the flue gas temperature of not more than 0.5° F (0.28° C) in three successive readings taken 15 minutes apart, and then a third flue gas temperature measurement shall be made to determine the off-period minimum flue gas temperature ($T_{F,\,OFF}(\infty)$). For units not equipped with a continuously operating pilot light, $T_{F,\,OFF}(\infty)$ shall be set equal to the measured room temperature (T_{RA}) and the unit shall remain off for a minimum time period of 20 minutes.

During the cool-down test, the energy input rate to the pilot light (Q_P), if the unit is so equipped, shall be measured with an error no larger than ±3 percent. Record all measured values.

3.2.4 Gas- and oil-fueled condensing boilers. After steady state testing is completed, the main burner(s) shall be turned off and the flue gas temperature measured at 3.75 ($T_{F,\,OFF}(t_3)$) and 22.5 ($T_{F,\,OFF}(t_4)$) minutes after the burner(s) shuts off, using the thermocouple grid described in section 2.6. During this off-period, no water shall be allowed to circulate through the boiler. A third flue gas temperature shall be made 45 minutes after the burner(s) shuts off to determine the off-period minimum flue gas temperature ($T_{F,\,OFF}(\infty)$). During this cool-down test, the energy input rate to the pilot light (Q_P), if the unit is so equipped, shall be measured with an error no larger than ±3 percent. For units equipped with flue dampers, the damper shall be closed during the cool-down test. Record all measured values.

29. Section 3.3.1 of Appendix N to Subpart B is amended to read as follows:

3.3.1 Gas- and oil-fueled central furnaces (including direct vent systems and not including condensing furnaces). After equilibrium conditions are achieved following the cool-down test and the required measurements performed, turn on the furnace and measure the flue gas temperature using the termocouple grid described above, at 0.5 ($T_{F,\,ON}(t_1)$) and 2.5 ($T_{F,\,ON}(t_2)$) minutes after the main burner(s) comes on. After the burner start-up, delay the blower start-up by 1.5 minutes (t^-) unless: (1) the furnace employs a single motor to drive the power burner and the indoor air circulating blower, in which case the burner and blower shall be started together, or (2) the delay time would result in the activation of a temperature safety device which shuts off the burner, in which case the fan control shall be permitted to start the blower. In the latter case, if the fan control is adjustable, set it to start the burner at the highest temperature. If the fan control is permitted to start the blower, measure the time delay (t^-) using a stop watch. Record the measured temperatures. During the heat-up test for oil-fueled furnaces, maintain the draft in the flue pipe within ±0.01 inch of water gauge of the manufacturer's recommended on-period draft.

30. Section 3.3.2 of Appendix N to Subpart B is amended to read as follows:

3.3.2 Gas- oil-fueled boiler (including direct vent systems and not including condensing boilers). Fifty minutes after the main burner(s) is turned off for the cool-down test, turn on the steam or hot water boiler and measure the flue gas temperature using the thermocouple grid described above, at 1.0 ($T_{F,\,ON}(t_1)$) and 5.5 ($T_{F,\,ON}(t_2)$) minutes after the main burner(s) comes on. Start the pump circulating the water through the hot water boiler simultaneously with the main burner(s) and maintain the water flow rate at that maintained during the steady state test described in section 3.1. During the heat-up test for oil fired boilers, maintain the draft in the flue pipe within ±0.01 inch of water column of the manufacturer's recommended on-period draft. Record the measured temperatures.

31. Appendix N to Subpart B is amended by adding, at the end of section 3.3.2, the following new sections:

3.3.3 Gas- and oil-fueled condensing furnaces. After the cool-down test is completed, the furnace shall be turned on and the flue gas temperature measured using the thermocouple grid described in section 2.6 at 0.5 ($T_{F,\,ON}(t_1)$) and 2.5 ($T_{F,\,ON}(t_2)$) minutes after the main burner(s) comes on. During this on-period, there shall be a time delay (t^-) between the burner start-up and blower start-up of 1.5 minutes. Two exceptions to this are: (1) if the furnace employs a single motor to drive a power burner and an indoor air circulating blower, both shall be started together, and (2) if a 1.5 minute blower delay time results in the operation of the high limit control to shut the burner off, the fan control shall be permitted to automatically start the blower provided, if it is adjustable, it is set to turn the blower on at the highest flue gas temperature. If the fan control is permitted to start the blower, the time delay (t^-) between burner and blower start-up shall be measured using a stop watch. Record the measured values.

3.3.4 Gas- and oil-fueled condensing boilers. Fifty minutes after the main burner(s) is turned off for the cool-down test, the condensing boiler shall be turned on and the flue gas temperature measured using the thermocouple grid described in section 2.6 at 1.0 ($T_{F,\,ON}(t_1)$) and 5.5 ($T_{F,\,ON}(t_2)$) minutes after the main burner comes on. The pump circulating the water through the boiler shall be started simultaneously with the main burner(s), the water flow rate shall be the same as that maintained during the steady state test described in 3.1, and the return water temperature shall be within the limits specified in section 2.5.2.

32. Section 3.4(i) of Appendix N to Subpart B is amended to read as follows:

(i) Electric and gas-fueled gravity and forced-air central furnaces—ANSI Standard Z21.47–1973, section 2.9.1 and appendix F.

33. The first two sentences of 3.6 of Appendix N to Subpart B are amended to read as follows:

3.6 *Optional procedure for determining D_P, D_R, and D_S, for systems equipped with power burners, forced draft fans, and induced draft fans.* On systems which employ power burners, forced draft fans, or induced draft fans and do not employ a stack damper, or do employ a stack damper but with a draft diverter or draft hood, measure D_f (the ratio of gas mass flow rate through the flue during the off-cycle to the gas mass flow rate

through the flue during the on-cycle at identical temperatures) during the cool-down test described in section 3.2.

* * * * *

34. Appendix N to Subpart B is amended by adding the following new paragraph at the end of section 3.6:

* * * * *

For pulse combustion units, D_f and D_p shall be set equal to 0.0. For condensing units employing power burners, forced draft fans, or induced draft fans, the values of D_f and D_p may be obtained using the optional procedures described above in this section, except that the steady state conditions shall be indicated by a temperature variation in three successive readings, taken 15 minutes apart, of not more more than 1°F in the flue gas temperature in the case of furnaces and the supply (outlet) water temperature for hot water boilers.

35. Appendix N to Subpart B is amended by adding after section 3.6, the following new section:

3.7 *Optional procedure for condensing furnaces and boilers which have no off-period flue losses.* At the discretion of the manufacturer, the cool-down and heat-up tests specified in 3.2 and 3.3 may be omitted on pulse combustion units. In lieu of conducting the cool-down and heat-up tests, the manufacture may use the losses determined during the steady state test described in 3.1 when calculating part load efficiency (η_u).

36. Section 4.2.2 of Appendix N to Subpart B is amended to read as follows:

4.2.2 Ratio of combustion air to stoichiometric air. Determine the ratio of combustion air mass flow rate to stoichiometric air mass flow rate ($R_{T,F}$) for the test fuel from Figure 1 by using the value of dry flue gas CO_2 concentration ($X_{CO2,F}$) determined in accordance with section 3.1 of this appendix.

37. Section 4.2.5 of Appendix N to Subpart B is amended to read as follows:

4.2.5 Steady state efficiency. Calculate the steady state efficiency (excluding jacket loss) (η_{ss}) expressed in percent and defined as:

$\eta_{ss} = 100 - L_{L,A} - L_{G,SS,A}$, for non-condensing furnaces and boilers and condensing furnaces

and

$$\eta_{ss} = 100 - L_{L,A} - L_{G,SS,A} - \frac{(100)\,(.24)\,(180 - 120)\,(1 + R_{T,F})\,(A/F)}{HHV_A}$$

For condensing boilers where:

$L_{L,A}$ = average latent heat loss of the test fuel determined in accordance with Table 3, in percent.

$L_{G,SS,A}$ as defined in 4.2.4.

(.24) = specific heat of air.

(180) = rated return water temperature.

(120) = test return water temperature.

$R_{T,F}$ as defined in 4.2.2.

A/F = the stoichiometric air/fuel ratio determined in accordance with table 3.

100 = number which relates results in percentages.

HHV_A = average higher heating value of the test fuel determined in accordance with Table 3, in Btu's per pound.

38. Section 4.2.6 of Appendix N to Subpart B is amended to read as follows:

4.2.6 Average ratio of stack gas mass flow rate to flue gas mass flow rate at full-load steady state operation. Determine the average ratio of stack gas mass flow rate to flue gas mass flow rate at full-load steady state operation (S/F) for the system number to be tested from table 1 or 2.

39. Appendix N to Subpart B is amended by adding in the equation in section 4.2.8 a minus sign, "—", between the two terms of the numerator.

40. Appendix N to Subpart B is amended by changing the fourth and fifth paragraphs of section 4.2.13 to read:

D_P = off-cycle flue gas draft factor selected from table 1 or, for units with power burners, induced draft fans, or forced draft fans where D_p is measured, determined in accordance with section 4.4.2 of this appendix.

D_S = off-cycle stack gas draft factor selected from table 1 or, for units with power burners, induced draft fans, or forced draft fans where D_P is measured, determined in accordance with section 4.4.3 of this appendix.

41. Section 4.2.15 of Appendix N to Subpart B is amended to read as follows:

4.2.15 Correction factors for systems 9–12. Calculate a correction factor which corrects for the use of outdoor air for combustion instead of air at room temperature (C_s) defined as:

for non-condensing furnaces:

$$C_s = 1 + \frac{(70 - 42)\,\eta_{ss}}{(T_{F,SS} - T_{RA})\,100}$$

for condensing furnaces:

$$C_s = \frac{T_{F,SS} - 42}{T_{F,SS} - 70}$$

where:

42 = average outdoor temperature corresponding to 5,200 degree day location, in degrees fahrenheit.

η_{ss} as defined in 4.2.5.

$T_{F,SS}$ as defined in 4.2.4.

70 assumed average indoor air temperature.

T_{RA} as defined in 4.2.4.

The correction factor which corrects for the effect of outdoor air passing through the heat exchanger during the off-period, C'_s is defined as: $C'_s = 1.22$

42. Appendix N to Subpart B is amended by changing the second paragraph of section 4.2.22 to read as follows:

For systems 1–8 and condensing units:

* * *

43. Appendix N to Subpart B is amended by changing the third paragraph of section 4.2.22 to read as follows:

For systems 9–12 except condensing units:

* * *

44. Appendix N to Subpart B is amended by changing section 4.2.32 to read as follows:

4.2.32 Latent heat loss coefficient. For condensing furnaces, calculate the latent heat loss coefficient expressed as a decimal and defined as:

$$\text{If } P_V \geq P_V^S$$

$$C_L = \frac{P_V^S}{P_V} \times \frac{14.7 - P_V}{14.7 - P_V^S}$$

$$\text{If } P_V < P_V^S$$

$$C_L = 1.0$$

where:

$$P_V = \frac{M_V}{M_{FG}} \times \frac{m_{FG}}{m_V} (14.7),$$

is the water vapor partial pressure that would be in the flue gases if there were no condensation and the atmospheric pressure were equal to 14.7 psia.

14.7 = standard atmospheric pressure in psia.

M_V = 18, is the approximate molecular weight of water.

M_{FG} =

29.0 for No. 1 and No. 2 fuel oil

28.0 for natural gas

27.5 for manufactured gas

28.5 butane and propane, are the approximate apparent molecular weights of flue gases for different fuels.

$$m_{FG} = 1 + \left[(A/_F)\ (R_{T,F})\right]$$

is the weight of flue gases generated per unit weight of fuel burnt.

$$m_v = \frac{(HHV_A\ \ (L_{L,A}))}{(100)\qquad (1053.3)}$$

(HHV_A) as defined in 4.2.5
$(L_{L,A})$ as defined in 4.2.5
$(A/_F)$ as defined in 4.2.5
$(R_{T,F})$ as defined in 4.2.5
(1053.3) is assumed latent heat/lb. of water
P_v^s = saturated vapor pressure determined from Table 5 at average flue gas temperature $\bar{T}_{F,ON}$.

where:

If the option described in 3.7 is not employed:

$$\bar{T}_{F,ON} = T_{F,SS} - \frac{\theta_{F,O}\ 1 - e^{-(t_{ON}/\tau_{ON})}}{(t_{ON}/\tau_{ON})}$$

If the option described in 3.7 is employed: $\bar{T}_{F,ON} = T_{F,SS}$

where:

$T_{F,SS}$ as defined in 4.2.4.
$\theta_{F,O}$ as defined in 4.2.22.
t_{ON} as defined in 4.2.20.
τ_{ON} as defined in 4.2.20.

45. Appendix N to Subpart B is amended by renumbering existing section 4.2.33 to 4.2.35.

46. Appendix N to Subpart B is amended by adding a new section 4.2.33 to read as follows:

4.2.33 Condensate heat loss. For condensing furnaces, calculate the loss due to condensate going down the drain and correct for the fact that this condensate did not go up the flue as heated vapor (as was assumed in determining $L_{s,\ ss,\ A}$), expressed as a percent and defined as:

$$L_C = \frac{L_{L,A}\ (1 - C_L)\ \left[1.0(T_{F,SS} - 70) - .45\ (T_{F,SS} - 42)\right]}{1053.3}$$

where:

$T_{F,SS}$ as defined in 4.2.4.
.45 specific heat of water vapor
1.0 specific heat of water (liquid)
70 as defined in 4.2.15
42 as defined in 4.2.15
C_L as defined in 4.2.32
$L_{L,A}$ as defined in 4.2.5
1053.3 latent heat vaporization of water

47. Appendix N to Subpart B is amended by adding a new section 4.2.34 to read as follows:

4.2.34 Part-load fuel utilization efficiency. Calculate the part-load fuel utilization efficiency, expressed as a percent and defined as:

If the option described in 3.7 is not employed:

$$\eta_U = 100 - C_L\ L_{L,A} - L_C - C_J\ L_J - \frac{t_{on}}{t_{on} + \frac{Q_p}{Q_{in}}\ (t_{off})} \left[L_{S,ON} + L_{S,OFF} + L_{I,ON} + L_{I,OFF}\right]$$

If the option described in 3.7 is employed:

$$\eta_U = 100 - C_L L_{L,A} - L_C - C_J L_J - \frac{t_{on}}{t_{on} + \frac{(Q_p)}{Q_{in}}\ (t_{off})} \left[C_S L_{S,SS,A}\right]$$

where:

C_J = 0 for furnaces or boilers intended to be installed indoors, 3.3 for furnaces intended to be installed outdoors, and 4.7 for boilers intended to be installed outdoors.
C_S as defined in 4.2.15.
C_L = 1 for non-condensing furnaces or boilers, and as determined in 4.2.32 for condensing furnaces or boilers.
t_{on} as defined in 4.2.20.
t_{off} as defined in 4.2.21.
Q_p = pilot flame fuel input rate determined in accordance with section 3.2 of this Appendix, in Btu's per hour.
Q_{in} = steady state heat input rate (incuding pilot flame fuel input rate) determined in accordance with section 3.1 of this Appendix, in Btu's per hour.
L_J = jacket loss determined in accordance with section 3.4 of this Appendix, in percent.
$L_{L,A}$ as defined in 4.2.5.
t_{on} as defined in 4.2.20.
t_{off} as defined in 4.2.21.
$L_{s,\ on}$ as defined in 4.2.28.
$L_{s,\ off}$ as defined in 4.2.29.
$L_{I,\ on}$ as defined in 4.2.30.
$L_{I,\ off}$ as defined in 4.2.31.
$L_{S,\ SS,\ A}$ as defined in 4.2.4.
L_C = 0 for non-condensing furnaces or boilers, and as determined in 4.2.33 for condensing furnaces or boilers.

48. Appendix N to Subpart B is amended by changing in sections 4.4.1, 4.4.2, 4.4.3, and 4.5, the words "power burner" to "power burner, induced draft fan or forced draft fan."

49. Section 4.4 of Appendix N to Subpart B is amended by adding a paragraph at the end of the section to read as follows:

* * * * *

For direct exhaust systems utilizing indoor air for combustion and employing forced or induced draft shall be tested as a direct vent system without preheating of combustion air. The test data for the type of furnace shall be reduced as a system number 2 with S/F = 1, and $D_s = D_f = 0.4$ or D_p if the unit is not equipped with a flue damper, and as a system number 8 with S/F = 1, $D_f = 0.4$ or D_p, and $D_s = (0.4)\ D_o$ or $(D_p)\ (D_o)$, if the unit is equipped with a flue damper.

50. Appendix N to Subpart B is amended by changing the fourth

paragraph of section 4.7 to read as follows:

$Q_{out}=(\eta_{ss}/100)$ (nameplate input) rounded off to the nearest 1,000 Btu/hr for units intended for installation in a heated space, $Q_{out}=(\eta_{ss}/100—(3.3)\ (L_J/100))$ (nameplate input) rounded off to the nearest 1,000 Btu/hr for units intended for installation outdoors or in an unheated space, and $Q_{out}=(\eta_{ss}/100)—(L_J/100)$ (nameplate input) rounded off to the nearest 1,000 Btu/hr for finned tubed boilers intended for installation outdoors or in an unheated space.

51. Appendix N to Subpart B is amended by changing in section 4.7 the defined term "O_{ss} as defined in 4.2.5" to "η_{ss} as defined in 4.2.5."

52. Appendix N to Subpart B is amended by changing the cite "4.2.32" in section 4.7 to "4.2.34."

53. Appendix N to Subpart B is amended by adding at the end of section 4.7 the defined term:

nameplate input as defined in section 1.3.

54. Appendix N to Subpart B is amended by adding a new section 4.15 after existing section 4.14 to read as follows:

4.15 *Energy factor for furnaces.*

Calculate the energy factor for gas and oil-fueled furnaces*, E_F, defined as:

$$E_F = \left[\frac{(\eta_u/100)\ [E_F - (4600\ Q_P)]}{E_F + 3413\ E_{AE}}\right] (100)$$

Where:

η_u is the part-load fuel utilization-efficiency defined in 4.2.34.

E_F is the average annual fuel energy consumption as defined in section 4.8.

4600 as defined in 4.2.35.

Q_P as defined in 4.2.35.

E_{AE} is the average annual auxiliary electric energy consumption as defined in 4.9.

3413 conversion factor corresponding to 1 kilowatt=3414 Btu/hour.

*Set the energy factor for electric-furnaces equal to the annual fuel utilization-efficiency as defined in 4.1.

55. Appendix N to Subpart B is amended by changing the title of Table 1 to read as follows:

Factors Describing Air Flow Rate for Gas- and Oil-Fired Non-Condensing Furnaces or Boiler Utilizing Indoor Air for Combustion and Draft Control.

56. Appendix N to Subpart B is amended by adding to the title of Table 2 the phrase "and All Condensing Furnaces or Boilers" at the end of the existing title.

57. Appendix N to Subpart B is amended by adding to Table 4 the following line items preceding the existing line items:

5,000 to 10,000	5	5
11,000 to 16,000	10	5, 10
17,000 to 25,000	15	10, 15

58. Appendix N to Subpart B is amended by adding a new Table 5 after existing Table 4 to read as follows:

Table 5.—*Saturated Vapor Pressure at Different Temperatures*

Temperature (°F):	Pressure (lb./in²a)
700	3094.3
600	1543.2
500	680.86
400	247.259
300	67.005
200	11.526
180.0	7.5110
179.0	7.3460
178.0	7.1840
177.0	7.0250
176.0	6.8690
175.0	6.7159
174.0	6.5656
173.0	6.4182
172.0	6.2736
171.0	6.1318
170.0	5.9926
169.0	5.8562
168.0	5.7223
167.0	5.5911
166.0	5.4623
165.0	5.3361
164.0	5.2124
163.0	5.0911
162.0	4.9722
161.0	4.8556
160.0	4.7414
159.0	4.6294
158.0	4.5197
157.0	4.4122
156.0	4.3068
155.0	4.2036
154.0	4.1025
153.0	4.0035
152.0	3.9065
151.0	3.8114
150.0	3.7184
149.0	3.6273
148.0	3.5381
147.0	3.4508
146.0	3.3653
145.0	3.2816
144.0	3.1997
143.0	3.1195
142.0	3.0411
141.0	2.9643
140.0	2.8892
139.0	2.8157
138.0	2.7438
137.0	2.6735
136.0	2.6047
135.0	2.5375
134.0	2.4717
133.0	2.4074
132.0	2.3445
131.0	2.2830
130.0	2.2230
129.0	2.1642
128.0	2.1068
127.0	2.0507
126.0	1.9959
125.0	1.9424
124.0	1.8901
123.0	1.8390
122.0	1.7891
121.0	1.7403
120.0	1.6927
119.0	1.6463
118.0	1.6009
117.0	1.5566
116.0	1.5133
115.0	1.4711
114.0	1.4299
113.0	1.3898
112.0	1.3505
111.0	1.3123
110.0	1.2750
109.0	1.2385
108.0	1.2030
107.0	1.1684
106.0	1.1347
105.0	1.10174
104.0	1.06965
102.0	1.00789
101.0	0.97818
100.0	0.94924
99.0	0.92103
98.0	0.89356
97.0	0.86679
96.0	0.84072
95.0	0.81534
94.0	0.79062
93.0	0.76655
92.0	0.74313
91.0	0.72032
90.0	0.69813
89.0	0.67653
88.0	0.65551
87.0	0.63507
86.0	0.61518
85.0	0.59583
84.0	0.57702
83.0	0.55872
82.0	0.54093
81.0	0.52364
80.0	0.50683
79.0	0.49049
78.0	0.47461
77.0	0.45919
76.0	0.44420
75.0	0.42964
74.0	0.41550
72.0	0.38844
71.0	0.37549
70.0	0.36292
69.0	0.35073
68.0	0.33889
67.0	0.32740
66.0	0.31626
65.0	0.30545
64.0	0.29497
63.0	0.28480
62.0	0.27494
61.0	0.26538

Table 5.—*Saturated Vapor Pressure at Different Temperatures*—Continued

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